

# **Comparison of 250 MHz R10K Origin 2000 and 400 MHz Origin 2000 Using NAS Parallel Benchmarks**

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## **Introduction**

This report describes results of benchmark tests on Steger, a 250 MHz Origin 2000 system with R10K processors, currently installed at the NASA Ames National Advanced Supercomputing (NAS) facility. For comparison purposes, the tests were also run on Lomax, a 400 MHz Origin 2000 with R12K processors.

The BT, LU, and SP application benchmarks in the NAS Parallel Benchmark Suite and the kernel benchmark FT were chosen to measure system performance. Having been written to measure performance on Computational Fluid Dynamics applications, these benchmarks are assumed appropriate to represent the NAS workload. Since the NAS runs both message passing (MPI) and shared-memory, compiler directive type codes, both MPI and OpenMP versions of the benchmarks were used. The MPI versions used were the latest official release of the NAS Parallel Benchmarks, version 2.3. The OpenMP versions used were PBN3b2, a beta version that is in the process of being released. NPB 2.3 and PBN 3b2 are technically different benchmarks, and NPB results are not directly comparable to PBN results.

Links to descriptions of the benchmarks themselves:

NPB description

PBN description

All runs were Class C, and compiled with 64-bit addressing. The MPI programs were compiled with the -O2 compiler flag, described as extensive optimization by the SGI compiler man pages. The OpenMP runs were compiled with the -O3 compiler flag, the highest level of optimization on the Origin. Different flags were used because the MPI BT Class C benchmark ran faster when compiled with the -O2 flag. After running the MPI benchmarks it was discovered that this was not the case for all benchmarks, so the -O3 flag, normally the faster option, was used for the Open MP benchmarks. When the MPI benchmarks were run compiled with the -O3 flag on Steger, the timings were within 5% of the times obtained compiling with -O2, so compiler flag choice did not significantly affect the results.

## **Summary of Results**

The mean, median, and standard deviation of the timings and MOPS counts for each benchmark are presented below in Tables 3, 4, 5 and 6. To get a reasonable sample, seven runs of each benchmark were done on each machine.

All runs were done on a machine controlled by a custom PBS scheduler written by Ed Hook. of CSC Corp working at the NASA NAS division, which uses cpusets and an awareness of machine topology to insure memory allocation and execution on physically contiguous nodes. Because the machines were space shared, not time shared, interference from other jobs was minimized. The lack of run time variation among benchmark runs supports this hypothesis.

**Table 3 - Steger - 250 MHz R10K - MPI results**

<b>BT Class C</b>	<b>Seconds</b>	<b>MOPS</b>
Median	2922.24	980.85
Mean	2925.58	979.75
Std. Dev.	120.77	4.77
<b>FT Class C</b>	<b>Seconds</b>	<b>MOPS</b>
Median	623.53	635.72
Mean	631.09	628.81
Std. Dev.	22.90	20.89
<b>LU Class C</b>	<b>Seconds</b>	<b>MOPS</b>
Median	1266.25	1610.26
Mean	1266.93	1609.40
Std. Dev.	2.38	3.02
<b>SP Class C</b>	<b>Seconds</b>	<b>MOPS</b>
Median	1894.96	765.24
Mean	1894.41	765.47
Std. Dev.	4.23	1.71

Hardware info:

IRIX64 steger 6.5 10120851 IP27

256 250 MHZ IP27 Processors

CPU: MIPS R10000 Processor Chip Revision: 3.4

FPU: MIPS R10010 Floating Point Chip Revision: 3.4

Main memory size: 65536 Mbytes

Instruction cache size: 32 Kbytes

Data cache size: 32 Kbytes

Secondary unified instruction/data cache size: 4 Mbytes

**Table 4 - Lomax - 400 MHz R12K Origin 2000 MPI Results**

<b>BT Class C</b>	<b>Seconds</b>	<b>MOPS</b>
Median	1365.21	2099.52
Mean	1354.28	2117.47
Std. Dev.	31.68	50.31
<b>FT Class C</b>	<b>Seconds</b>	<b>MOPS</b>
Median	278.71	1421.48
Mean	276.88	1432.07
Std. Dev.	5.36	28.03
<b>LU Class C</b>	<b>Seconds</b>	<b>MOPS</b>
Median	1494.65	1364.20
Mean	1503.03	1356.88
Std. Dev.	23.97	21.15
<b>SP Class C</b>	<b>Seconds</b>	<b>MOPS</b>
Median	1422.39	1019.48
Mean	1431.55	1013.26
Std. Dev.	28.11	18.81

Hardware info:

IRIX64 steger 6.5 10120851 IP27

256 250 MHZ IP27 Processors

CPU: MIPS R10000 Processor Chip Revision: 3.4

FPU: MIPS R10010 Floating Point Chip Revision: 3.4

Main memory size: 65536 Mbytes

Instruction cache size: 32 Kbytes

Data cache size: 32 Kbytes

Secondary unified instruction/data cache size: 4 Mbytes

**Table 6 - Lomax - 400 MHz R12K OpenMP**